4.3.1.1.2 Soils

The following soils occur commonly in the area west of Par Pond (see Figure 4-9) (USDA 1990):

- Blanton sand, 0 to 6 percent slopes (BaB)
- Fluvaquents, frequently flooded (Fa)
- Fuquay sand, 2 to 6 percent slopes (FuB)

4.3.1.2 Environmental Impacts

4.3.1.2.1 No Action

The erosion or deposition of soil and surface formations is likely to continue at the current rates. P-Reactor area is not operational. No contamination of geology or soils at Par Pond would occur since there is no active outfall. TE

4.3.1.2.2 Shut Down and Deactivate

If DOE deactivated the River Water System, Par Pond would no longer have the capability to receive river water. Soils are already known to be contaminated at Par Pond. DOE believes natural fluctuations will maintain lake levels above 195 feet (59.4 meters) above mean sea level through recharge by groundwater. Without the River Water System, DOE would not be able to refill Par Pond. TE TC

4.3.1.2.3 Shut Down and Maintain

The impacts discussed above for the Shut Down and Deactivate Alternative would apply to this alternative. However, if Par Pond levels fell below the 195-foot (59.4-meter) level, DOE could restart the River Water System to refill the lake.

4.3.2 SURFACE WATER

4.3.2.1 Affected Environment

Par Pond was a cooling water reservoir for P- and R-Reactors until 1964, when DOE shut R-Reactor down (Wilde 1985). It continued to receive heated cooling water until 1988, when DOE shut P-Reactor down (Paller and Wike 1996a). TE

4.3.2.1.1 Water Quality

Because watershed contributions to Par Pond (through rainfall and natural drainage) are considerably lower in nutrients than water pumped from the Savannah River, the addition of water to Par Pond through the River Water System resulted in nutrient enrichment. On the basis of its water chemistry and biological community characteristics, Par Pond is an oligotrophic to mesotrophic lake (reservoir).

A comprehensive biological monitoring program conducted from November 1985 to December 1992 investigated the L-Lake/Steel Creek System. During the latter part of this study, from 1990 to 1992, DOE used one sampling location on Par Pond, near the dam, for data comparison. The 1990-1992 water quality data from this location reflect post-reactor operation conditions, as listed in Table 4-48 (Wike et al. 1994). TE

In 1991 the water level of Par Pond was reduced from its historic level of 200 feet (61 meters) above mean sea level to 181 feet (55.2 meters) above mean sea level because of a defect in the Par Pond Dam. The drawdown began in June 1991 and the water level reached 181 feet by September 1991. DOE repaired the dam and refilled Par Pond to its previous level in early 1995. Par Pond was extensively studied before, during, and after the drawdown, resulting in the generation of considerable information on contaminant levels in the ecosystem and ecological changes resulting from the drawdown.

In February 1995 DOE began biweekly sampling to monitor changes in water chemistry during the refilling of Par Pond to its full pool, approximately 200 feet (61 meters) above mean sea level. The sampling program measures and monitors parameters and constituents that could quickly indicate impending anoxia (oxygen depletion) or eutrophication (nutrient enrichment).

TE | **Table 4-48.** Water quality parameters for Par Pond near the dam (January 1990-December 1991).

Item	Mean	Range	Number of samples
Water temperature (°C)	18.1	8.5-31	96
pH	6.33	5.54-7.25	84
Dissolved oxygen (mg/l)	6.01	0.02-11.6	96
Specific conductance (μmhos/cm)	70.0	46-126	96
Total suspended solids (mg/l)	2.02	0-10	96
Alkalinity (mg $CaCO_3$/l)	14.6	6.73-40.3	96
Chloride (mg/l)	5.73	3.25-8.0	28
Sulfate (mg/l)	4.62	3.6-7.8	28
Total calcium (mg/l)	3.42	2.44-4.72	28
Total magnesium (mg/l)	0.84	0.593-1.04	28
Total sodium (mg/l)	6.15	3.07-9.05	28
Total potassium (mg/l)	1.04	0.54-1.38	28
Total aluminum (mg/l)	0.032	0.006-0.109	28
Total iron (mg/l)	0.517	0.015-3.63	28
Total manganese (mg/l)	0.251	0.006-137	28
Total phosphorus (mg/l)	0.032	0.008-0.28	1,000
Ortho-phosphate (mg/l)	0.007	0-0.238	999
Total Kjeldhal Nitrogen (mg/l)	0.302	0-1.03	1,000
Ammonia (mg N/l)	0.046	0-0.891	1,000
Nitrite (mg N/l)	0.003	0-0.026	1,000
Nitrate (mg N/l)	0.073	0-0.385	999

Results of the sampling through September 1995 indicated that dissolved oxygen and nutrient concentrations generally remained within the range expected for southeastern reservoirs (Koch, Martin, and Westbury 1996).

In September 1995 DOE collected sediment and water samples as part of a study that included an investigation of contaminant levels in Par Pond sediments and water, and how the drawdown and refill affected contaminant levels. The sediment sample analyses included total mercury, while the water sample analyses included total mercury and EPA target analyte list metals (Paller and Wike 1996a).

Mercury, a toxic metal, was present in detectable concentrations at 20 percent of the sample sites; elevated levels of mercury have accumulated in sediments from pumping water from the Savannah River. The average concentration, 39 parts per billion, was below the EPA Region IV sediment screening value (130 parts per billion; EPA 1995). However, the highest mercury concentration, 323 parts per billion, exceeded the EPA Region IV screening value for mercury in sediments. The highest mercury concentrations occurred in deeper portions of Par Pond.

In addition, surface sediment samples were collected in Par Pond to assess the potential ecological effects of contaminants in Par Pond sediments (Paller and Wike 1996b). Although the maximum detected value exceeded the EPA Region IV screening level, the average concentration (77 parts per billion) did not.

None of the metals measured in Par Pond water samples exceeded EPA Region IV acute toxicity screening values for surface waters (EPA 1995). However, the detection limits for beryllium, cadmium, lead, mercury, and silver were not low enough to ensure that these metals were below EPA Region IV surface-water chronic toxicity screening values.

Data collected before and after the Par Pond drawdown and refill suggest the refill had little effect on contaminant levels in the aquatic ecosystem. There was no evidence of long-term resuspension of contaminants in the water or of extensive redistribution of contaminants as a result of sediment movements [although localized downslope movements of contaminants on the exposed shoreline during the drawdown remain a possibility (Paller and Wike 1996a)].

4.3.2.1.2 Water Quantities

Par Pond has a mean depth of approximately 20 feet (6.2 meters), a maximum depth of approximately 59 feet (18 meters) near the dam, a shoreline length of approximately 33 miles (53 kilometers), and a storage volume of approximately 52,800 acre-feet (65 million cubic meters) at an elevation of approximately 200 feet (61 meters) above mean sea level (Wilde 1985).

4.3.2.1.3 Water Usage

In January 1996 DOE stopped pumping river water to Par Pond to enable water levels to fluctuate naturally between a full pool of approximately 200 feet (61 meters) and 195 feet (59.4 meters) above mean sea level. DOE accomplished this by diverting flows from National Pollutant Discharge Elimination System Outfall P-19, which normally discharges to Par Pond, to NPDES Outfall P-13, which discharges to the headwaters of Steel Creek above L-Lake. The current primary effluents to Outfall P-19 are the P-Area 186-basin overflow (pumped river water), nonprocess cooling water, building drains, and stormwater.

Although DOE discontinued reactor operations in 1988, it pumped river water through Outfall P-19 to Par Pond until January 1996 (except during the Par Pond dam repairs) at 7 to 10 cubic feet (0.2 to 0.3 cubic meter) per second to maintain historic water levels. Since January 1996, the water level has fluctuated naturally and has not decreased below 199 feet (60.7 meters) (Sidey 1996). Initial modeling exercises indicated that, without river water contributions, levels in Par Pond would fluctuate seasonally with rainfall, runoff, and evaporation, with pool levels ranging from 197 to 199 feet (60.1 to 60.7 meters) above mean sea level (DOE 1995a); however, these exercises had some uncertainty due to assumptions they made about the groundwater system at Par Pond. Due to a lack of information of the hydrologic system in the area, the analysis assumed for modeling purposes that net groundwater flow into the pond was zero (i.e., flow in equals flow out).

Subsequently, DOE conducted a water balance study of the Par Pond hydrologic system to estimate the rate of groundwater flow to Par Pond. The results of the study suggest that Par Pond gains water from the groundwater system in its upper reaches but loses water to the groundwater system near the dam. The rate of groundwater flow from the water table aquifer into Par Pond was 13 cubic feet (0.37 cubic meter) per second. The rate of flow from Par Pond to the water table aquifer near the dam was 7 cubic feet (0.2 cubic meter) per second. This results in a net groundwater flow of 6 cubic feet (0.2 cubic meter) per second from the aquifer to Par Pond. Table 4-49 lists the water budget components that represent actual flows in or out of Par Pond (Hiergesell and Dixon 1996).

Table 4-49. Inflow and outflow terms (cubic feet per second).[a,b]

TE

Inflow Terms	
Water budget component	Long-term average flux rate
Precipitation over Par Pond	13
Surface runoff entering Par Pond	11
Groundwater seepage into Par Pond	13
Long-term average canal inflow to Par Pond	23
Total	60
Outflow Terms	
Water budget component	Long-term average flux rate
Evapotranspiration from Par Pond	13
Seepage loss to groundwater	7
Spillway discharge	40
Total	60

a. Source: Hiergesell and Dixon (1996).
b. To convert cubic feet to cubic meters, multiply by 0.02832.

Using the water balance results, data on Par Pond water levels with 5,000 gallons per minute (0.32 cubic meters per second) continuous release and a full pool of 200 feet (61 meters) above mean sea level indicate that the reservoir remains above 197 feet (60.2 meters) above mean sea level more than 95 percent of the time, based on the revised model predictions (Gladden 1996a).

4.3.2.2 Environmental Impacts

4.3.2.2.1 No Action

There would be no impacts to Par Pond surface water resources if DOE decided to implement the No-Action Alternative. The SRS ceased river water inputs to Par Pond in January 1996 and allowed the water level to fluctuate naturally from its current actual full pool level of approximately 200 feet (61 meters) above mean sea level. DOE allows the water level to fluctuate from a full pool of approximately 200 feet to 195 feet (59.4 meters). Although the Par Pond water level has not decreased below 199 feet (60.7 meters) since January 1996, it could fluctuate by as much as several feet in response to seasonal changes in rainfall and evaporation. Considerable research on the effects of fluctuating water levels in reservoirs indicates that fluctuations are not harmful and might even be beneficial if they are not extreme and match the fluctuations generally characteristic of a normal hydrological cycle (i.e., high in spring and low in late fall and early winter). Fluctuations in the Par Pond water level would follow natural patterns. Under this alternative, DOE would maintain the capability to resume river water inputs to Par Pond if water levels dropped below 195 feet (59.4 meters).

The cessation of river water inputs has resulted in the reduction of nutrients entering Par Pond from the Savannah River. The reservoir is likely to change from a moderately productive state to a water body that more closely resembles typical southeastern reservoirs that do not experience substantial nutrient input (DOE 1995a).

4.3.2.2.2 Shut Down and Deactivate

Surface-water impacts under this alternative would be the same as those discussed for No Action except DOE would lose the capability to restart the river water pumps and refill Par Pond to an appropriate level if one of the monitored indicator values (e.g., a water quality parameter or a biotic index) exceeded established threshold levels.

4.3.2.2.3 Shut Down and Maintain

Surface-water impacts to Par Pond under this alternative would be the same as those discussed for No Action.

4.3.3 GROUNDWATER

This section describes the site-specific groundwater conditions near the Par Pond aquifers.

4.3.3.1 Affected Environment

Aquifer Units

Section 4.1.3 discusses the regional hydrogeology. The water table aquifer discharges along the edges of Par Pond (Hiergesell 1996). Based on a review of Well No. P24 on cross sections (Aadland, Gellici, and Thayer 1995), the first confined aquifer occurs at approximately 100 feet (30 meters) above mean sea level and approximately 100 feet below the mean reservoir water elevation.

Groundwater Flow

The water table aquifer flows away from P-Area (west to east) (see Figure 4-12) and discharges to the west side of Par Pond. Specific hydraulic properties for the water table aquifer are limited in the Par Pond area, so Table 4-1 uses sitewide hydraulic properties of the water table aquifer. According to the pontentiometric surface map of the first confined aquifer (Figure 4-12), groundwater flows in a south/ southeast direction below and away from Par Pond. Data on the hydraulic properties of the first confined aquifer in the Par Pond area are also limited and sitewide data are used here as well (Table 4-2). Water from Par Pond recharges both aquifers below the dam. Therefore, water in Par Pond does not directly affect the first confined aquifer. According to assumptions used in Hiergesell (1996), there is a leakage from Par Pond through the water table aquifer and into the first confined aquifer. Based on a review of hydrostratigraphic cross sections and maps (Aadland, Gellici, and Thayer 1995), groundwater is apparently not connected (i.e., a groundwater mound exists between lakes) between Par Pond and L-Lake aquifers. TE

Groundwater Quality and Usage

The quality of groundwater has been adversely impacted in P- and R-Areas west of Par Pond (WSRC 1996e). However, the extent of that impact is not fully known and is under investigation. The SRS does not use the water table aquifer or first confined aquifer in the area of Par Pond. TE

4.3.3.2 Environmental Impacts

4.3.3.2.1 No Action

Currently, Par Pond receives no River Water System outfall discharges. Therefore, the River Water System has no current effect on either aquifer in the vicinity of Par Pond. By continuing the operation of the River Water System, DOE does not anticipate any future effects on either aquifer at Par Pond.

4.3.3.2.2 Shut Down and Deactivate

The outfall from the River Water System does not currently contribute to the groundwater in either aquifer at Par Pond. Therefore, the groundwater flow rates, flow direction, and water quality in both aquifers would not be affected by a shutdown alternative. The overall groundwater contribution to the lake elevation would remain essentially constant, and there would be no change in the current groundwater contribution from Par Pond to the water table